The River Mile Framework

Sixth - Eighth Grades

TRM Connections to Washington State Revised Science Standards

Working Model
2/12/2010

TRM Essential Question: How do we simultaneously use and protect our watershed?

Guiding Questions:

How can scientific thinking help us analyze TRM systems, micro to macro & across time?
How will we develop and use scientific models to explain TRM systems?
How do we use inquiry and investigation to solve real problems at TRM site?

EALR 1 - Systems: Inputs, Outputs, Boundaries & Flows	
Look at a complex situation and see how it can be analyzed as a system with boundaries, inputs, outputs, and flows.	• Consider TRM site as a system. Identify the subsystems (e.g., landforms, soil composition, water supply, water quality, and populations of plants, animals, insects, fishes & birds). • Determine how the boundaries of a system can be drawn to fit the purpose of your study (e.g., 1. To study how the changes in native plant populations, due to introduction of a non-native species, affect the TRM system you might draw a 1 ft. wide boundary perpendicular with water's edge and going inland 100 ft. deep. 2. To study the impact of water quality on fish populations, you might draw the boundary five feet wide into the water and running parallel to the shoreline for the entire river mile with samples taken every quarter mile.) • Find evidence at TRM that the output of matter or energy from one system becomes the input for another system (e.g., decaying tree becomes the host for insects, fungi, seeds, and animal homes). • Find evidence at TRM of an open system where matter flows into and out of the system. Find evidence at TRM of a closed system where energy may flow into or out of the system but the matter stays within the system. • Identify a complex issue at TRM (e.g., human & pet waste on the shorelines) and describe the issue from a systems point of view highlighting how changes in one part of the system (e.g., providing porta-potties) is likely to influence other parts of the system (e.g., cost, maintenance, increased use of the area by humans impacting plants and animal inhabitants).

EALR 2 - Inquiry: Questioning & Investigation	
Investigate an answerable question through valid experimental techniques. Conclusions are based on evidence and are repeatable.	• Generate a question about TRM that can be answered through scientific investigation. • Work collaboratively with a team to plan and conduct a scientific investigation (e.g., field study or observation at TRM, controlled experiment, model or simulation in the lab). • Communicate your results using data (e.g., photos, drawings, tables, charts, diagrams, graphic displays and text that are clear accurate & informative). • Recognize and interpret patterns as well as variations. Use statistical procedures (e.g., median, mean, and mode) to analyze data and make inferences about relationships. • Plan and conduct a controlled experiment to test a hypothesis about a relationship between two variables. • Create a model or simulation to represent the behavior of TRM objects, events, systems and/or processes. • Generate a scientific conclusion and prepare a written report. • Engage in reflection and self evaluation. • Repeat the investigation and compare the results.
EALR 3 - Application: Science, Technology, & Problem Solving	
Work with other members of a team to apply the full process of technological design and relevant science concepts to solving a problem.	• Investigate several professions related to TRM in which science & technology is required, (e.g., NPS Ranger, Department of Fish and Wildlife biologist, hydroelectric dam operator, Department of Ecology water quality researchers). • Formulate a problem impacting TRM that can be solved by the technological design process. Identify the criteria for success. Brainstorm solutions, Test the solution using a model. Research how others have solved similar problems. • Compare and contrast the benefits and unintended consequences of science and technology to native habitat like TRM in industrialized and developing nations. • Describe scientific contributions by people in various cultures. What can indigenous peoples teach us about stewardship of the land?

EALR 4 - Physical Science: Force & Motion Balance & Unbalanced Forces	
Objects in motion are affected by balanced and unbalanced forces. Speed and direction of motion change due to these forces.	• Measure the distance an insect or small animal at TRM travels in a given interval of time and calculate the object's average speed, using S=d/t. Use tools like a tape measure and stop watch. • Illustrate the motion of a bird flying over TRM using a graph or infer the motion of a bird from a graph of the bird's position vs. time or speed vs. time. • Observe TRM shoreline and determine if the water is exerting balance or unbalanced force. Justify your premise with observational evidence. • Identify rocks, pebbles, and sand of different masses. Observe them on TRM shoreline and predict which will move farther or faster when hit by the water's wave action. Measure the results. Research data on the amount or size of waves produced by ski boats and pleasure boats in relation to their speed. Is this balanced or unbalanced force? How does boat wake change the amount of friction produced by water? Infer the impact of motor boat activity on TRM shoreline erosion. Consider the boat's speed and its distance from shore. What boating regulations might be needed to protect TRM shorelines from erosion?
EALR 4 - Physical Science: Properties & Change Atoms & Molecules	
Substances have unique properties based on their atomic structure. As atoms combine in a closed system their mass is conserved.	• Identify the intrinsic properties of water (e.g., density, boiling point, freezing point, solubility of other substances, and surface tension). • Sample & record water at TRM and identify any elements or compounds and the amounts that are dissolved in the water (e.g., dissolved oxygen, nitrates, phosphates, total alkalinity, and hardness). Record water & air temperature. Do variations in temperature change the level of solution for different compounds? Use the NPS water meter and collect 3-4 water quality data sets, every quarter mile, at TRM. GPS the locations

	for future tests. At the same locations collect water samples to analyze in the lab. Temperature and dissolved oxygen must be tested at TRM site within minutes of collecting the water sample. Test for PH. Compare and contrast the results of the electric probe and lab testing. • Do the water tests indicate that the substances found are mechanically mixed, dissolved in solution, or bonded with water? • How can water quality be restored if the substances are mechanically mixed, dissolved in solution, or bonded with water? • Research the substances impacting TRM water quality (e.g., chemicals of concern: metals such as mercury; and organics such as polychlorinated biphenyls or PCBs). Propose a solution to remove or reduce them to healthy levels for humans, fish, & wildlife.
EALR 4 - Physical Science: Energy: Transfer, Transformation, & Conservation Interaction of Energy & Matter	
Energy and matter interact resulting in energy transfers & transformations. There are multiple forms of energy.	• Observe TRM and find evidence of heat, light, chemical, electrical, kinetic, and sound energy. Describe ways in which energy is transformed from one form to another and transferred from one place to another (e.g., Light from the sun is transformed into chemical energy in a plant. The plant is eaten by a mule deer and the chemical energy is transformed into kinetic energy and body heat as the deer walks. The deer polishes its new antlers on a tree and the kinetic energy is transformed into sound energy which vibrates across the meadow to the ears of an alert wolf pack that begins pursuit). • At TRM, develop an inquiry to find examples of radiation, conduction, convection and mechanical mixing to illustrate the transfer of heat energy from warmer objects to cooler ones. You might test and record your body reactions by sitting on a hot boulder in the sun and a colder boulder in the shade or at a different time of year. Measure the temperature of the water and sand separately and then mix the two in a small pool. What happens to the temperature? Or measure the water temperature at different depths and explain any difference.

	• Design an inquiry to explain how insulation, TRM tree & plant canopy, slows the transfer of heat to the water. Compare water temperature between a shaded and an open section of shoreline. Compare the dissolved oxygen (DO) levels. What is the relationship between water temperature and DO levels? Research the range of temperatures & DO that are needed for healthy fish & reproduction. How might logging affect water temperatures & fish survival? • During a TRM Sit Spot, listen and record sounds. For each sound identify the source of the vibrations which create the sound. (e.g., wind vibrating the ponderosa pine branches, feet of a grey squirrel scampering over pebbles & rocks, flapping wings of a red tail hawk, vocal chords & beak of a song sparrow, or the drumming beak of a Downey woodpecker on a snag).
EALR 4 - Earth & Space Science: The Solar System	
Our Solar System is held together by gravity. Moon phases & eclipses are explained.	• Develop an inquiry and research how plant & animal behavior at TRM changes based on the cycle of day & night. • Does the moon's monthly cycle and changing light reflection impact plant, animal and human activity? Are nocturnal predators more active during a full or new moon? What would constitute evidence?
EALR 4 - Earth & Space Science: Earth Systems, Structures, & Processes Cycles in Earth Systems	
Earth is an interacting system of solids, liquids, & gasses. Important Earth processes include the water cycle and the rock cycle.	• Find evidence at TRM of solids, liquids & gasses. Draw a model to show how the solids, liquids & gasses interact. In what ways is the system at TRM balanced or unbalanced? Consider the availability of air, water & habitat for plant & animal survival. • Find evidence of the water cycle at TRM site. Draw a schematic of TRM water cycle. • Water is a solvent. It dissolves gasses and carries them to the ocean. How does this water property a benefit to fish survival? Research dissolved oxygen needed for fish survival.

	• How does this property of water negatively impact fish populations living in rivers dammed by hydroelectric power plants? Research how dams increase the nitrogen level in water and the impact of nitrogen bubbles on fish survival. • Water is a solvent. It dissolves minerals and carries them downstream. How does this water property impact the level of toxic metals in Lake Roosevelt? How have metals like zinc and cadmium traveled from Trail, Canada to beach sediments hundreds of miles downriver? • At TRM, find evidence of the rock cycle. Locate & identify igneous, metamorphic, and sedimentary rocks. Are all three types visible? Which type is most common? Make a map of TRM showing the major rock outcroppings and research how the rocks may have changed over time. • Identify the predominant landforms at TRM (e.g., mountain, hill, plateau, valley, or beach). Explain the earth processes that have shaped TRM (e.g., volcanic activity, crustal uplifting, earthquakes, weathering, erosion and deposition). How have TRM landforms changed since construction of the Grand Coulee Dam? • What is the relationship between the type of rocks and the landforms at TRM?
EALR 4 - Earth & Space Science: Earth History Evidence of Change	
Layers of rocks and different types of fossils provide clues to how conditions on Earth have changed over time.	• Make a map of TRM showing the major rock outcroppings and landforms. • Research the Missoula Floods and volcanic activity to speculate on how the rocks and land formations may have changed over geologic time. • Make a model to show changes that may occur in the future if the predictions of climate change are correct.

EALR 4 - Life Science: Structures & Function of Living Systems From Cells to Organisms	
Cell type and organization provide living systems structure and function.	**In the classroom and lab** students use microscopes to draw and describe observations of plant and animal cells. They learn about the function of cells for sustaining living organisms, including single celled organisms. Students have studied the structure and function of body systems (e.g., digestive, circulatory, & respiratory systems and how these systems interact. Students have developed models to compare the cell structure and functions of plant & animal cells. • At TRM students apply their study of internal and external structures and behavior to identify and classify organisms observed at the site. • Evaluate data on TRM water quality. Does TRM water environment provide sufficient oxygen, temperature ranges, & pH levels for fish survival and reproduction? Are some species of fish more likely to survive than others? How are the organisms that fish consume (e.g., algae and macro invertebrates) impacted by changes in water quality? • Based on observation and evidence, which organisms at TRM have the greatest threat of being harmed by different types of pollution or environmental degradation (e.g., introduction of non-native organisms, human & animal organic waste, increased water temperatures due to logging, high concentrations of nitrates & phosphates in water samples, beer bottles, cans and trash left by human use, land fills, and air born dust containing metals)?
EALR 4 - Life Science: Ecosystems Flow of Energy through Ecosystems	
Energy flows through ecosystems from a primary source through all living organisms.	• Identify & map the ecosystems and their boundaries within TRM site include populations of organisms and non-living components. TRM geographical area may contain many different ecosystems. • Analyze the flow of energy in an identified TRM ecosystem. Draw and label a food-web showing the relationship between the plant & animal populations. Identify where in the system the sun's energy is transformed through photosynthesis to produce the chemical energy in food.

	• Predict what may happen to TRM ecosystem if non-living factors change (e.g., amount of light, range of temperatures, or availability of water). • Investigate a TRM environmental issue by defining the problem, researching possible causative factors, understanding the underlying science, and evaluating the benefits and risks of alternative solutions. • Identify resource uses that reduce the capacity of ecosystems to support various populations (e.g., use of pesticides, construction, or logging).
EALR 4 - Life Science: Biological Evolution Inheritance, Variation & Adaptation	
Multiple lines of evidence support biological evolution. These include genetics, reproduction, adaptation & speciation.	**In the classroom and laboratory** students investigate biological evolution and diversity of species. They understand the ideas of sexual and asexual reproduction and the survival advantage of genetic variation. • At TRM observe an identified ecosystem and predict which organisms are most likely to disappear from this environment when the environment changes in specific ways (e.g., increased temperature, reduction of available water or introduction of a non-native species). • Find evidence of a plant or animal adaptation that would provide a survival and reproductive advantage given an environmental change such as increased temperature, reduction of available water or introduction of a non-native species.
Stewardship of Our River Mile	
	Research actions the Colville Federated Tribes, the Spokane Tribe of Indians, the Washington State Department of Ecology, the Environmental Protection Agency, the NPS and local agencies are taking to protect the Lake Roosevelt Watershed. Select a project of interest and find out what you and your family or classmates can do to become involved in protecting the LR watershed.

Units of Study that can be reinforced by visits to The River Mile location are:

FOSS Kit: Catastrophic Events
FOSS Kit: Diversity of Life
FOSS Kit: Earth History
FOSS Kit: Energy, Machines & Motion
FOSS Kit: Environments
FOSS Kit: Food & Nutrition
FOSS Kit: Human Body Systems
FOSS Kit: Landforms
FOSS Kit: Levers & Pulleys
FOSS Kit: Light
FOSS Kit: Planetary Science
FOSS Kit: Populations & Ecosystems
FOSS Kit: Properties of Matter
FOSS Kit: Solar Energy
FOSS Kit: Variables

Teacher Developed units: Inheritance, variations and adaptations, Cells to organisms, Ranges of tolerance for plants; Channeled scab lands, Missoula floods, Trip to Grand Coulee Dam, Lower Granite Dam and outer boundary dam trip to Gardner Caves North of Ione. Catastrophic events, geologic formation of basalt columns, using GPS to identify location, Erosion & the impact on spawning grounds

NPS Resource Managers Related Projects & Programs: